York University

EECS 3101Z

Homework Assignment #10 Due: April 10, 2023 at 7:00 p.m.

Both of the following questions can be answered by constructing a graph and then using the graph algorithms from the textbook. This means that no sophisticated algorithms need to be designed, but when you describe the construction of the graph, you should precisely specify:

- is it directed or undirected,
- the set of nodes,
- whether each pair of nodes is connected by an edge or not,
- weights on edges (if any),
- any other important details (such as the number of nodes or edges in your graph, which may be useful for bounding the running time of your algorithm).

Then, describe how you would use one of the textbook graph algorithms to solve the problem.

1. You are given a few random pages from a dictionary for a foreign language. Words are listed on each page in alphabetical order, but you don't know what order the pages go in. The language uses an alphabet that you are not familiar with. For instance, the first two words on the page are: uquupnipint

ազնիվ

From this, you can conclude that u precedes u in the language's alphabet. You would like to construct an ordering of the letters in the alphabet that is consistent with all of the pages of the dictionary that you have. (This ordering might not be unique). There are n pages with w words on each page. What is the worst-case running time of your solution?

2. You are given a map of Leutonia's rail network, where segments of the railways connect cities. There are c cities and t segments of track connecting pairs of cities. A foreign army has just begun an invasion of the eastern part of Leutonia and has captured just one city, Zorensk. To prevent the foreign army from getting any further, the Leutonian army has decided to destroy some railway segments. In particular, the Leutonians want to ensure that there is no way to get from Zorensk to the capital city of Moldenau by rail. (A train can run on a track in either direction.) The Leutonians are confident that they will eventually win the war, and then they will have to rebuild any railway tracks they destroy now. Each railway segment between two cities has an associated cost of rebuilding it later. (For example, segments that tunnel through the Leutonians want to find the set of railway segments to destroy so that the total cost of rebuilding the whole rail network later is minimized, while still ensuring that there is no connection path rom Zorensk to Moldenau.